The documentation and process conversion measures necessary to comply with this revision shall be completed by 5 February 2004.

INCH-POUND

MIL-PRF-19500/564F
5 November 2003
SUPERSEDING
MIL-PRF-19500/564E
22 December 1997

PERFORMANCE SPECIFICATION

SEMICONDUCTOR DEVICE, FIELD EFFECT TRANSISTOR, P-CHANNEL, SILICON
TYPES 2N6849, 2N6849U, 2N6851 AND 2N6851U
JAN, JANTX, JANTXV, JANS, JANHC, AND JANKC

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the performance requirements for a P-channel, enhancement-mode, MOSFET, power transistor. Four levels of product assurance are provided for each encapsulated device type as specified in MIL-PRF-19500. Two levels of product assurance are provided for each unencapsulated device type.

* 1.2 Physical dimensions. See figures 1, TO-205AF (formerly TO-39), 2 (LCC), and figure 3 for JANHC and JANKC die dimensions.

* 1.3 Maximum ratings. Unless otherwise specified, T_C = +25°C.

Type	P_T (1) T_C = +25°C	P_T T_A = +25°C	V_{DS}	V_{DG}	V_{GS}	I_{D1} (2) (3) T_C = +25°C	I_{D2} (2) T_C = +100°C	I_S	I_{DM} (4)	T_J and T_{STG}
	W	W	V dc	V dc	V dc	A dc	A dc	A dc	A (pk)	°C
2N6849, 2N6849U	25	0.8	-100	-100	±20	-6.5	-4.1	-6.5	-25	-55 to +150
2N6851, 2N6851U	25	0.8	-200	-200	±20	-4.0	-2.4	-4.0	-20	-55 to +150

(1) Derated linearly by 0.2 W/°C for T_C > +25°C;
(2) The following formula derives the maximum theoretical I_D limit. I_D is limited by package and internal wires and may be limited by pin diameter:

$$I_D = \sqrt{\frac{T_{JM} - T_C}{(R_{\theta JC}) \times (R_{DS}(on) \text{ at } T_{JM})}}$$

(3) See figure 4, maximum drain current graph.
(4) I_{DM} = 4 x I_{D1} as calculated in note 2.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Defense Supply Center, Columbus, ATTN: DSCC-VAC, Post Office Box 3990, Columbus, OH 43216-5000, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

1.4 Primary electrical characteristics. Unless otherwise specified, T_C = +25°C.

Type	Min $V_{(BR)DSS}$ V_{GS} = 0 V I_D = -1 mA dc	$V_{GS(th)1}$ $V_{DS} \geq V_{GS}$ I_D = -0.25 mA	Max I_{DSS1} V_{GS} = 0 V	Max $r_{DS(on)1}$ (1) V_{GS} = -10 V dc $I_D = I_{D2}$		$R_{\theta JC}$ maximum
			V_{DS} = 80 percent of rated V_{DS}	T_J = +25°C	T_J = +150°C	
	V dc	V dc	µA dc	ohm	ohm	°C/W
		Min Max				
2N6849, 2N6849U	-100	-2.0 -4.0	-25	0.30	0.60	5.0
2N6851, 2N6851U	-200	-2.0 -4.0	-25	0.80	1.68	5.0

(1) Pulsed, (see 4.5.1).

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

* 2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATION

DEPARTMENT OF DEFENSE

MIL-PRF-19500 - Semiconductor Devices, General Specification for.

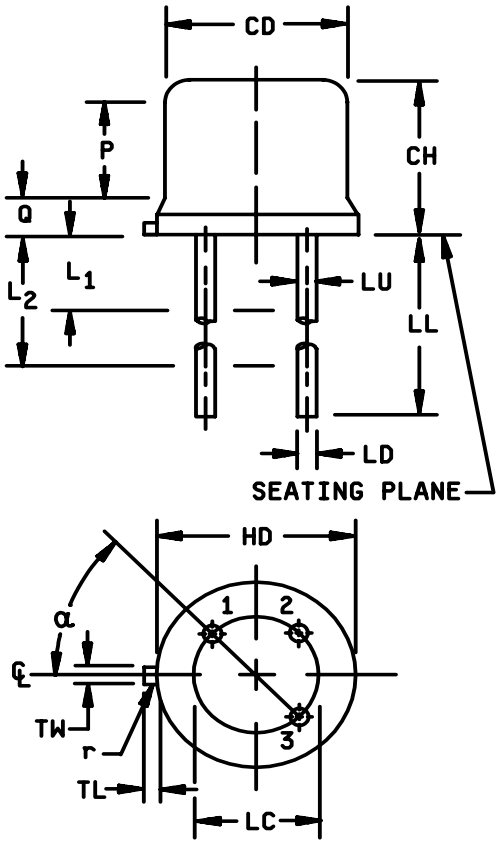
STANDARD

DEPARTMENT OF DEFENSE

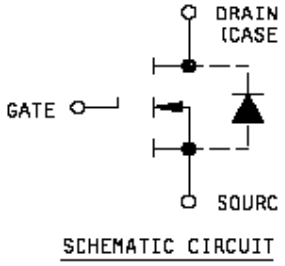
MIL-STD-750 - Test Methods for Semiconductor Devices.

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Document Automation and Production Services (DAPS), Building 4D (DPM-DODSSP), 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

* 2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.



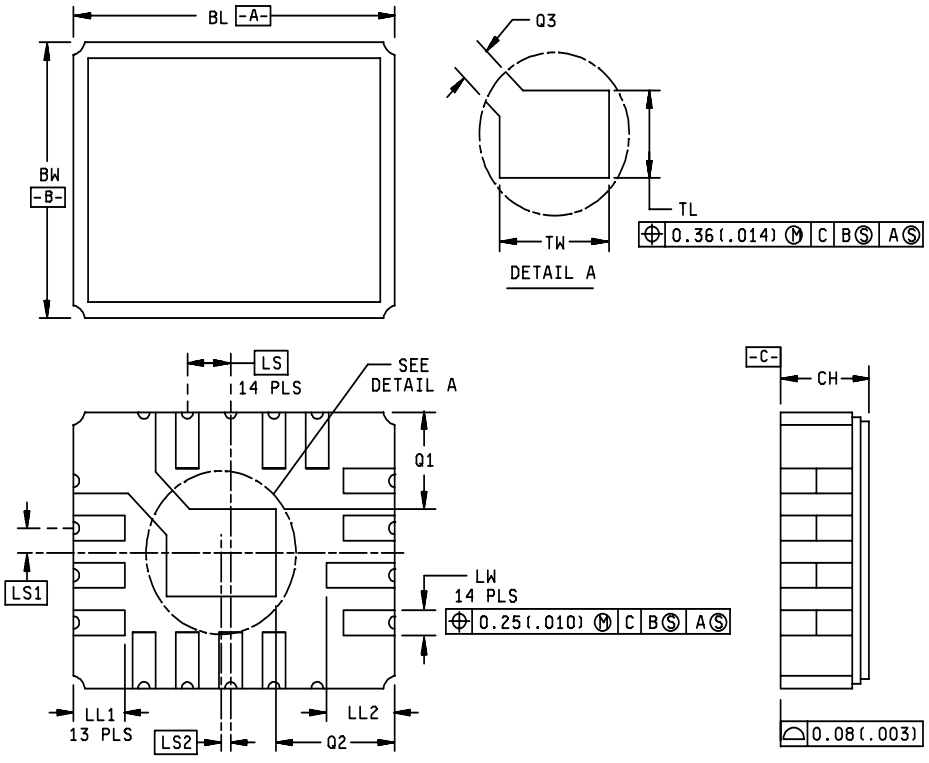
Ltr	Dimensions				
	Inches		Millimeters		Notes
	Min	Max	Min	Max	
CD	.305	.335	7.75	8.51	
CH	.160	.180	4.07	4.57	
HD	.335	.370	8.51	9.39	
LC	.200 TP		5.08 TP		6
LD	.016	.021	0.41	0.53	7, 8
LL	.500	.750	12.7	19.05	7, 8
LU	.016	.019	0.41	0.48	7, 8
L1		.050		1.27	7, 8
L2	.250		6.35		7, 8
P	.100		2.54		5
Q		.050		1.27	4
r		.010		0.25	9
TL	.029	.045	0.74	1.14	3
TW	.028	.034	0.72	0.86	2
α	45° TP		45° TP		6

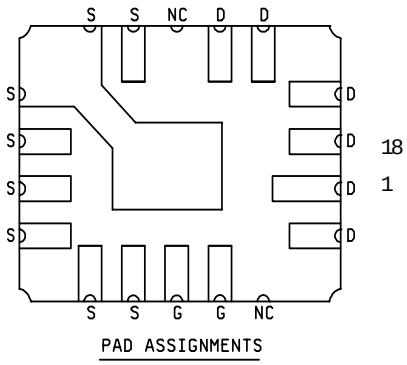


SCHEMATIC CIRCUIT

NOTES:
1. Dimensions are in inches. Millimeters are given for general information only.
2. Beyond radius (r) maximum, TW shall be held for a minimum length of .011 (0.028 mm).
3. Dimension TL measured from maximum HD.
4. Outline in this zone is not controlled.
5. Dimension CD shall not vary more than .010 (0.25 mm) in zone P. This zone is controlled for automatic handling.
6. Leads at gauge plane .054 +.001, -.000 (1.37 +0.03, -0.00 mm) below seating plane shall be within .007 (0.18 mm) radius of true position (TP) at maximum material condition (MMC) relative to tab at MMC. LU applies between L_1 and L_2. LD applies between L_2 and LL minimum. Diameter is uncontrolled in L_1 and beyond LL minimum.
8. All three leads.
9. Radius (r) applies to both inside corners of tab.
10. Drain is electrically connected to the case.
11. In accordance with ASME Y14.5M, diameters are equivalent to ϕx symbology.
12. Lead 1 = source, lead 2 = gate, lead 3 = drain.

* FIGURE 1. Physical dimensions for TO-205AF (2N6849 and 2N6851).



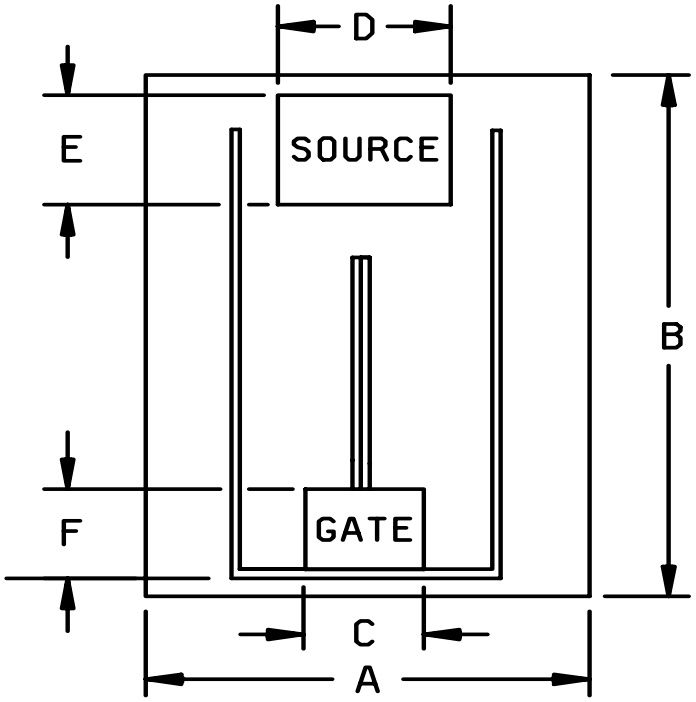


Dimensions				
Sym.	Inches		Millimeters	
	Min	Max	Min	Max
BL	.345	.360	8.77	9.14
BW	.280	.295	7.11	7.49
CH	.095	.115	2.41	2.92
LL1	.040	.055	1.02	1.40
LL2	.055	.065	1.40	1.65
LS	.050 BSC		1.27 BSC	
LS1	.025 BSC		0.635 BSC	
LS2	.008 BSC		0.203 BSC	
LW	.020	.030	0.51	0.76
Q1	.105 REF		2.67 REF	
Q2	.120 REF		3.05 REF	
Q3	.045	.055	1.14	1.40
TL	.070	.080	1.78	2.03
TW	.120	.130	3.05	3.30

NOTES:
1. Dimensions are in inches.
2. Millimeters are given for general information only.
3. In accordance with ASME Y14.5M, diameters are equivalent to ϕx symbology.

* FIGURE 2. Physical dimensions for LCC (2N6849U and 2N6851U).

2N6849 and 2N6851



Dimensions								
Ltr	2N6849				2N6851			
	Inches		Millimeters		Inches		Millimeters	
	Min	Max	Min	Max	Min	Max	Min	Max
A	.106	.122	2.69	3.10	.108	.124	2.74	3.15
B	.172	.188	4.37	4.78	.173	.189	4.39	4.80
C	.021	.029	0.53	0.74	.022	.030	0.56	0.76
D	.035	.043	0.89	1.09	.030	.038	0.76	0.97
E	.028	.036	0.71	0.91	.021	.029	0.53	0.74
F	.014	.022	0.36	0.56	.012	.020	0.30	0.51

NOTES:
1. Dimensions are in inches.
2. Millimeters are given for general information only.
3. The physical characteristics of the die are: The back metals are chromium, nickel, and silver and comprise the drain. The top metal is aluminum.
4. Die thickness is .0187 inch (0.475 mm), the tolerance is ±.0050 inch (±0.13 mm).
5. In accordance with ASME Y14.5M, diameters are equivalent to ϕx symbology.

* FIGURE 3. JANHCA and JANKCA die dimensions.

3. REQUIREMENTS

* 3.1 General. The individual item requirements shall be as specified in MIL-PRF-19500 and as modified herein.

* 3.2 Qualification. Devices furnished under this specification shall be products that are manufactured by a manufacturer authorized by the qualifying activity for listing on the applicable qualified manufacturer's list (QML) before contract award (see 4.2 and 6.5).

* 3.3 Abbreviations, symbols, and definitions. Abbreviations, symbols, and definitions used herein shall be as defined in MIL-PRF-19500 and as follows:

nC - nano Coulomb.

* 3.4 Interface and physical dimensions. The Interface and physical dimensions shall be as specified in MIL-PRF-19500, and on figures 1 (TO-205AF), 2 (LCC), 3, 4, and 5 (JANHC/JANKC die) herein.

* 3.4.1 Lead material and finish. Lead material shall be Kovar, Alloy 52, and a copper core is permitted (for TO-205AF). Lead finish shall be solderable in accordance with MIL-PRF-19500, MIL-STD-750, and herein. Where a choice of lead finish is desired, it shall be specified in the acquisition requirement (see 6.3).

* 3.4.2 Internal construction. Multiple chip construction shall not be permitted.

* 3.5 Marking. Marking shall be in accordance with MIL-PRF-19500. At the option of the manufacturer, marking of country of origin may be omitted from the body of the transistor, but shall be retained on the initial container.

3.6 Electrostatic discharge protection. The devices covered by this specification require electrostatic protection.

* 3.6.1 Handling. MOS devices must be handled with certain precautions to avoid damage due to the accumulation of static charge. The following handling practices shall be followed:

a. Devices shall be handled on benches with conductive handling devices.

b. Ground test equipment, tools, and personnel handling devices.

c. Do not handle devices by the leads.

d. Store devices in conductive foam or carriers.

e. Avoid use of plastic, rubber, or silk in MOS areas.

f. Maintain relative humidity above 50 percent if practical.

g. Care shall be exercised, during test and troubleshooting, to apply not more than maximum rated voltage to any lead.

h. Gate must be terminated to source, $R \leq 100$ kΩ, whenever bias voltage is to be applied drain to source.

* 3.7 Electrical performance characteristics. Unless otherwise specified herein, the electrical performance characteristics are as specified in paragraph 1.3, 1.4, and table I.

* 3.8 Electrical test requirements. The electrical test requirements shall be the subgroups specified in paragraphs 4.4.2 and 4.4.3.

* 3.9 Workmanship. Semiconductor devices shall be processed in such a manner as to be uniform in quality and shall be free from other defects that will affect life, serviceability, or appearance.

4. VERIFICATION

* 4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

a. Qualification inspection (see 4.2).

b. Screening (see 4.3).

c. Conformance inspection (see 4.4 and tables I and II).

4.2 Qualification inspection. Qualification inspection shall be in accordance with MIL-PRF-19500 and table II herein. Alternate flow is allowed for qualification inspection in accordance with figure 4 of MIL-PRF-19500.

* 4.2.1 Group E qualification. Group E inspection shall be performed for qualification or re-qualification only. In case qualification was awarded to a prior revision of the specification that did not request the performance of table II tests, the tests specified in table II herein shall be performed by the first inspection lot of this revision to maintain qualification.

4.2.2 JANHC and JANKC die. Qualification shall be in accordance with appendix H of MIL-PRF-19500.

* 4.3 Screening (JANS, JANTX, and JANTXV levels only). Screening shall be in accordance with table IV of MIL-PRF-19500 and as specified herein. The following measurements shall be made in accordance with table I herein. Devices that exceed the limits of table I herein shall not be acceptable.

Screen (see table IV of MIL-PRF-19500) (1) (2)	Measurement	
	JANS level	JANTX and JANTXV levels
(3)	Gate stress test (see 4.3.2)	Gate stress test (see 4.3.2).
(3)	Method 3470 of MIL-STD-750 (see 4.3.3), optional	Method 3470 of MIL-STD-750 (see 4.3.3), optional
(3) 3c	Method 3161 of MIL-STD-750 (see 4.3.4)	Method 3161 of MIL-STD-750 (see 4.3.4)
9	I_{GSSF1}, I_{GSSR1}, I_{DSS1}, subgroup 2 of table 1 herein.	Subgroup 2 of table 1 herein.
10	Method 1042 of MIL-STD-750, test condition B	Method 1042 of MIL-STD-750, test condition B
11	I_{GSSF1}, I_{GSSR1}, I_{DSS1}, $r_{DS(on)1}$, $V_{GS(th)1}$ subgroup 2 of table I herein: ΔI_{GSSF1} = ± 20 nA dc or ± 100 percent of initial value, whichever is greater. ΔI_{GSSR1} = ± 20 nA dc or ± 100 percent of initial value, whichever is greater. ΔI_{DSS1} = ± 25 µA dc or ± 100 percent of initial value, whichever is greater.	I_{GSSF1}, I_{GSSR1}, I_{DSS1}, $r_{DS(on)1}$, $V_{GS(th)1}$ subgroup 2 of table I herein:
12	Method 1042 of MIL-STD-750, test condition A, t = 240 hours	Method 1042 of MIL-STD-750, test condition A
13	Subgroups 2 and 3 of table I herein; ΔI_{GSSF1} = ± 20 nA dc or ± 100 percent of initial value, whichever is greater. ΔI_{GSSR1} = ± 20 nA dc or ± 100 percent of initial value, whichever is greater. ΔI_{DSS1} = ± 25 µA dc or ± 100 percent of initial value, whichever is greater. $\Delta r_{DS(on)1}$ = ± 20 percent of initial value. $\Delta V_{GS(th)1}$ = ± 20 percent of initial value.	Subgroup 2 of table I herein; ΔI_{GSSF1} = ± 20 nA dc or ± 100 percent of initial value, whichever is greater. ΔI_{GSSR1} = ± 20 nA dc or ± 100 percent of initial value, whichever is greater. ΔI_{DSS1} = ± 25 µA dc or ± 100 percent of initial value, whichever is greater. $\Delta r_{DS(on)1}$ = ± 20 percent of initial value. $\Delta V_{GS(th)1}$ = ± 20 percent of initial value.

(1) At the end of the test program, I_{GSSF1}, I_{GSSR1}, and I_{DSS1} are measured.
(2) An out-of-family program to characterize I_{GSSF1}, I_{GSSR1}, I_{DSS1}, and $V_{GS(th)1}$ shall be invoked.
(3) Shall be performed anytime before screen 9.

* 4.3.1 Screening (JANHC and JANKC). Screening of die shall be in accordance with MIL-PRF-19500. As a minimum, die shall be 100-percent probed in accordance with table I, subgroup 2.

* 4.3.2 Gate stress test. Apply V_{GS} = ±30 V minimum for t = 250 µs minimum.

* 4.3.3 Unclamped inductive switching.

a. Peak current (I_D)..... Rated I_{D1}.

b. Peak gate voltage (V_{GS}) ..... -10 V dc.

c. Gate to source resistor (R_{GS}) ..... 25 Ω ≤ R_{GS} ≤ 200 Ω.

d. Initial case temperature (T_C) ..... +25°C +10°C, -5°C.

e. Inductance (L) ..... 100 µH ±10 percent.

f. Number of pulses to be applied ..... 1 pulse minimum.

g. Pulse repetition rate ..... None.

* 4.3.4 Thermal impedance ($Z_{\theta JC(max)}$ measurements). The $Z_{\theta JC}$ measurements shall be performed in accordance with method 3161 of MIL-STD-750. The maximum limit (not to exceed figure 5, thermal impedance curves and the table I, subgroup 2 limits) for $Z_{\theta JC}$ in screening (table IV of MIL-PRF-19500) shall be derived by each vendor by means of statistical process control. When the process has exhibited control and capability, the capability data shall be used to establish the fixed screening limit. In addition to screening, once a fixed limit has been established, monitor all future sealing lots using a random five piece sample from each lot to be plotted on the applicable X bar R chart. If a lot exhibits an out of control condition, the entire lot shall be removed from the line and held for engineering evaluation and disposition. This procedure may be used in lieu of an in line process monitor.

a. Measuring current (I_M)..... 10 mA.

b. Drain heating current (I_H) ..... 1 A minimum (1.3 A minimum for LCC).

c. Heating time (t_H)..... 10 ms.

d. Drain-source heating voltage (V_H)..... 25 V dc minimum (15 V minimum for LCC).

e. Measurement time delay (t_{MD})..... 30 to 60 µs.

f. t_{SW} sample window time..... 10 µs (maximum).

4.4 Conformance inspection. Conformance inspection shall be in accordance with MIL-PRF-19500. Alternate flow is allowed for conformance inspection in accordance with figure 4 of MIL-PRF-19500.

* 4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with MIL-PRF-19500 and table I herein. Electrical measurements (end-points) shall be in accordance with the inspections of table I, subgroup 2 herein.

* 4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the conditions specified for subgroup testing in table VIa (JANS) and table VIb (JAN, JANTX, and JANTXV) of MIL-PRF-19500 and herein. Electrical measurements (end-points) shall be in accordance with the inspections of table I, subgroup 2 herein.

* 4.4.2.1 Group B inspection, table VIa (JANS) of MIL-PRF-19500.

Subgroup	Method	Condition
B3	1051	Test condition G.
B3	2075	See 3.4.2 herein.
B3	2077	Scanning electron microscope (SEM) qualification may be performed anytime prior to lot formation.
B3	2037	Test condition A, all internal wired for each device shall be pulled separately.
B4	1042	Test condition D; 2,000 cycles. The heating cycle shall be 1 minute minimum.
B5	1042	Accelerated steady-state operation life; test condition A; V_{DS} = rated T_A = +175°C, t = 120 hours. Read and record $V_{(BR)DSS}$ (pre and post) at 1 mA = I_D. Read and record I_{DSS} (pre and post). Deltas for $V_{(BR)DSS}$ shall not exceed 10 percent and I_{DSS} shall not exceed 25 µA. Accelerated steady-state gate stress; condition B, V_{GS} = rated, T_A +175°C, t = 24 hours.
B5	2037	Bond strength; test condition A.
B6	3161	See 4.5.2.

4.4.2.2 Group B inspection, table VIb (JAN, JANTX, and JANTXV) of MIL-PRF-19500.

Subgroup	Method	Condition
B2	1051	Test condition G, 25 cycles.
B3	1042	Test condition D, 2,000 cycles. The heating cycle shall be 1 minute minimum.
B3	2037	Test condition A. All internal bond wires for each device shall be pulled separately.

* 4.4.3 Group C inspection. Group C inspection shall be conducted in accordance with the conditions specified for subgroup testing in table VII of MIL-PRF-19500 and as follows. Electrical measurements (end-points) shall be in accordance with the inspections of table I, subgroup 2 herein.

Subgroup	Method	Condition
C2	2036	Test condition E; weight = 8 ounces, 3 arcs of 90 degrees (Not required for LCC).
C5	3161	See 4.5.2.
C6	1042	Test condition D, 6,000 cycles. The heating cycle shall be 1 minute minimum.

* 4.4.4 Group E inspection. Group E inspection shall be conducted in accordance with the conditions specified for subgroup testing in table IX of MIL-PRF-19500 and as specified in table II herein. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein.

4.5 Methods of inspection. Methods of inspection shall be as specified in the appropriate tables and as follows.

4.5.1 Pulse measurements. Conditions for pulse measurement shall be as specified in section 4 of MIL-STD-750.

4.5.2 Thermal resistance. Thermal resistance measurements shall be performed in accordance with method 3161 of MIL-STD-750. $R_{\theta JC(max)}$ = 5.0°C/W.

a. Measuring current (I_M) ..... 10 mA.

b. Drain heating current (I_H)..... 1 A minimum (1.3 A minimum for LCC).

c. Heating time (t_H)..... Steady-state (see method 3161 of MIL-STD-750 for definition).

d. Drain-source heating voltage (V_H) ..... 25 V dc minimum (15 V minimum for LCC).

e. Measurement time delay (t_{MD}) ..... 10 to 80 µs.

f. Sample window time (t_{SW})..... 10 µs maximum.

* TABLE I. Group A inspection.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Condition		Min	Max	
Subgroup 1						
Visual and mechanical inspection	2071					
Subgroup 2						
Thermal impedance 2/	3161	See 4.3.4	$Z_{\theta JC}$		1.6	°C/W
Breakdown voltage, drain to source	3407	Bias condition C, V_{GS} = 0V, I_D = -1 mA dc	$V_{(BR)DSS}$			
2N6849, 2N6849U				-100		V dc
2N6851, 2N6851U				-200		V dc
Gate to source voltage (threshold)	3403	$V_{DS} \geq V_{GS}$, I_D = -0.25 mA	$V_{GS(th)1}$	-2.0	-4.0	V dc
Gate current	3411	Bias condition C, V_{GS} = ±20 V dc V_{DS} = 0 V dc	I_{GSS1}		±100	nA dc
Drain current	3413	Bias condition C, V_{GS} = 0 V dc, V_{DS} = 80 percent of rated V_{DS}	I_{DSS1}		-25	µA dc
Static drain to source on-state resistance	3421	V_{GS} = -10 V dc, condition A, pulsed (see 4.5.1), I_D = rated I_{D2} (see 1.3)	$r_{DS(on)1}$			
2N6849, 2N6849U					0.30	Ω
2N6851, 2N6851U					0.80	Ω
Static drain to source on-state resistance	3421	V_{GS} = -10 V dc, condition A, pulsed (see 4.5.1), I_D = rated I_{D1}, (see 1.3)	$r_{DS(on)2}$			
2N6849, 2N6849U					0.32	Ω
2N6851, 2N6851U					0.83	Ω
Forward voltage	4011	V_{GS} = 0 V dc, I_D = rated I_{D1}, pulsed (see 4.5.1)	V_{SD}			V
2N6849, 2N6849U					-4.3	V
2N6851, 2N6851U					-5.6	V

See footnote at end of table.

* TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Condition		Min	Max	
Subgroup 3						
High temperature operation:		$T_C = T_J = +125°C$				
Gate current	3411	Bias condition C, $V_{GS} = \pm 20$ V dc, $V_{DS} = 0$ V dc,	I_{GSS2}		±200	nA dc
Drain current	3413	Bias condition C, $V_{GS} = 0$ V dc, V_{DS} = 80 percent of rated V_{DS}	I_{DSS2}		-0.25	mA dc
Gate to source voltage (threshold)	3403	$V_{DS} \geq V_{GS}$, $I_D = -.25$ mA	$V_{GS(th)2}$	-1.0		V dc
Static drain to source on-state resistance	3421	$V_{GS} = -10$ V dc, pulsed (see 4.5.1), I_D = rated I_{D2}	$r_{DS(on)3}$			
2N6849, 2N6849U					0.54	Ω
2N6851, 2N6851U					1.60	Ω
Low temperature operation:		$T_C = T_J = -55°C$				
Gate to source voltage (threshold)	3403	$V_{DS} \geq V_{GS}$, $I_D = -.25$ mA	$V_{GS(th)3}$		-5.0	V dc
Subgroup 4						
Switching time test	3472	I_D = rated I_{D1}; $V_{GS} = -10$ V dc; gate drive impedance = 7.5 Ω;				
Turn-on delay time			$t_{d(on)}$			
2N6849, 2N6849U		$V_{DD} = -40$ V dc			60	ns
2N6851, 2N6851U		$V_{DD} = -75$ V dc			50	ns
Rise time			t_r			
2N6849, 2N6849U		$V_{DD} = -40$ V dc			140	ns
2N6851, 2N6851U		$V_{DD} = -75$ V dc			100	ns
Turn-off delay time			$t_{d(off)}$			
2N6849, 2N6849U		$V_{DD} = -40$ V dc			140	ns
2N6851, 2N6851U		$V_{DD} = -75$ V dc			80	ns
Fall time			t_f			
2N6849, 2N6849U		$V_{DD} = -40$ V dc			140	ns
2N6851, 2N6851U		$V_{DD} = -75$ V dc			80	ns

See footnotes at end of table.

* TABLE I. Group A inspection - Continued.

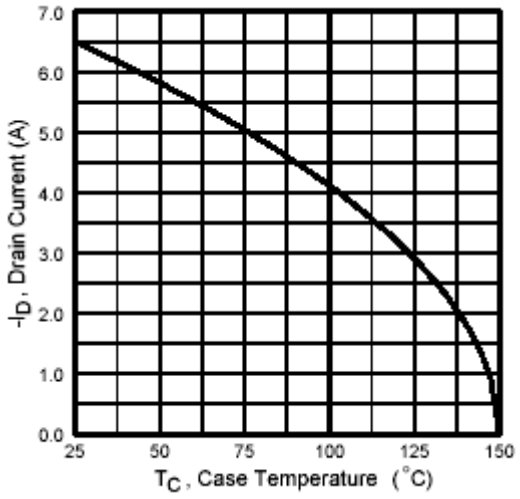
Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Condition		Min	Max	
Subgroup 5						
Single pulse unclamped inductive switching 3/	3470	See 4.3.3				
Electrical measurements		See table I, subgroup 2				
Safe operating area test (high voltage)	3474	See figure 6 t_p = 10 ms, V_{DS} = 80 percent of rated V_{DS}, $V_{DS} \leq$200 V dc max.				
Electrical measurements		See table I, subgroup 2				
Subgroup 6						
Not applicable						
Subgroup 7						
Gate charge	3471	Condition B				
On-state gate charge			$Q_{g(on)}$			
2N6849, 2N6849U					34.8	nC
2N6851, 2N6851U					34.8	nC
Gate to source charge			Q_{gs}			
2N6849, 2N6849U					6.8	nC
2N6851, 2N6851U					6.1	nC
Gate to drain charge			Q_{gd}			
2N6849, 2N6849U					23.1	nC
2N6851, 2N6851U					20.5	nC
Reverse recovery time	3473	$d_i/d_t \leq$ -100 A/µs, $V_{DD} \leq$ -50 V,	t_{rr}			
2N6849, 2N6849U		I_F = -6.5 A			250	ns
2N6851, 2N6851U		I_F = -4.0 A			400	ns

1/ For sampling plan, see MIL-PRF-19500.
2/ This test is required for the following end-point measurement only (not intended for screen 9, 11, or 13): JANS, table VIa of MIL-PRF-19500, group B, subgroups 3 and 4; JAN, JANTX, and JANTXV, table VIb of MIL-PRF-19500, group B, subgroups 2 and 3; and table VII of MIL-PRF-19500, group C, subgroup 6, and table IX of MIL-PRF-19500, group E, subgroup 1.
3/ This test is optional if performed as a 100 percent screen.

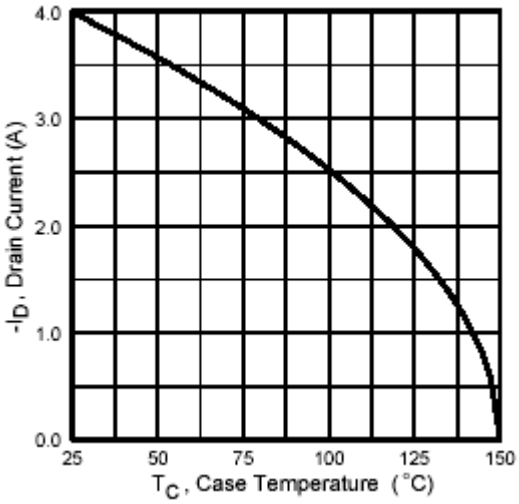
* TABLE II. Group E inspection (all quality levels) for qualification or re-qualification only.

Inspection	MIL-STD-750		Qualification inspection
	Method	Conditions	
Subgroup 1			12 devices c = 0
Temperature cycle	1051	Condition G, 500 cycles	
Hermetic seal			
Fine leak Gross leak			
Electrical measurements		See table I, subgroup 2	
Subgroup 2 1/			45 devices c = 0
Steady-state reverse bias	1042	Condition A, 1,000 hours	
Electrical measurements		See table I, subgroup 2	
Steady-state gate bias	1042	Condition B, 1,000 hours	
Electrical measurements		See table I, subgroup 2	
Subgroup 3			3 devices, c = 0
DPA	2102		
Subgroup 4			sample size N/A
Thermal impedance curves		Each supplier shall submit their (typical) design thermal impedance curves. In addition, test conditions and $Z_{\theta JX}$ limit shall be provided to the qualifying activity in the qualification report	
Subgroup 5			
Not applicable			
Subgroup 6			3 devices
ESD	1020	Not required for devices classified as ESD class 1.	
Subgroup 7			
Commutating diode for safe operating area test procedure for measuring dv/dt during reverse recovery of power MOSFET transistors or insulated gate bipolar transistors	3476		22 devices c = 0

1/ A separate sample for each test may be pulled.

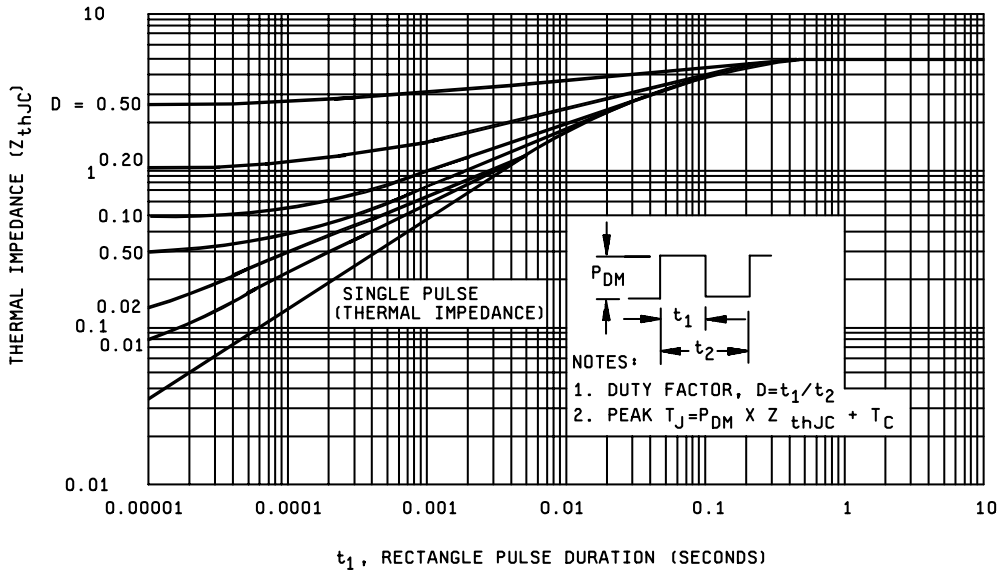


2N6849, 2N6849U



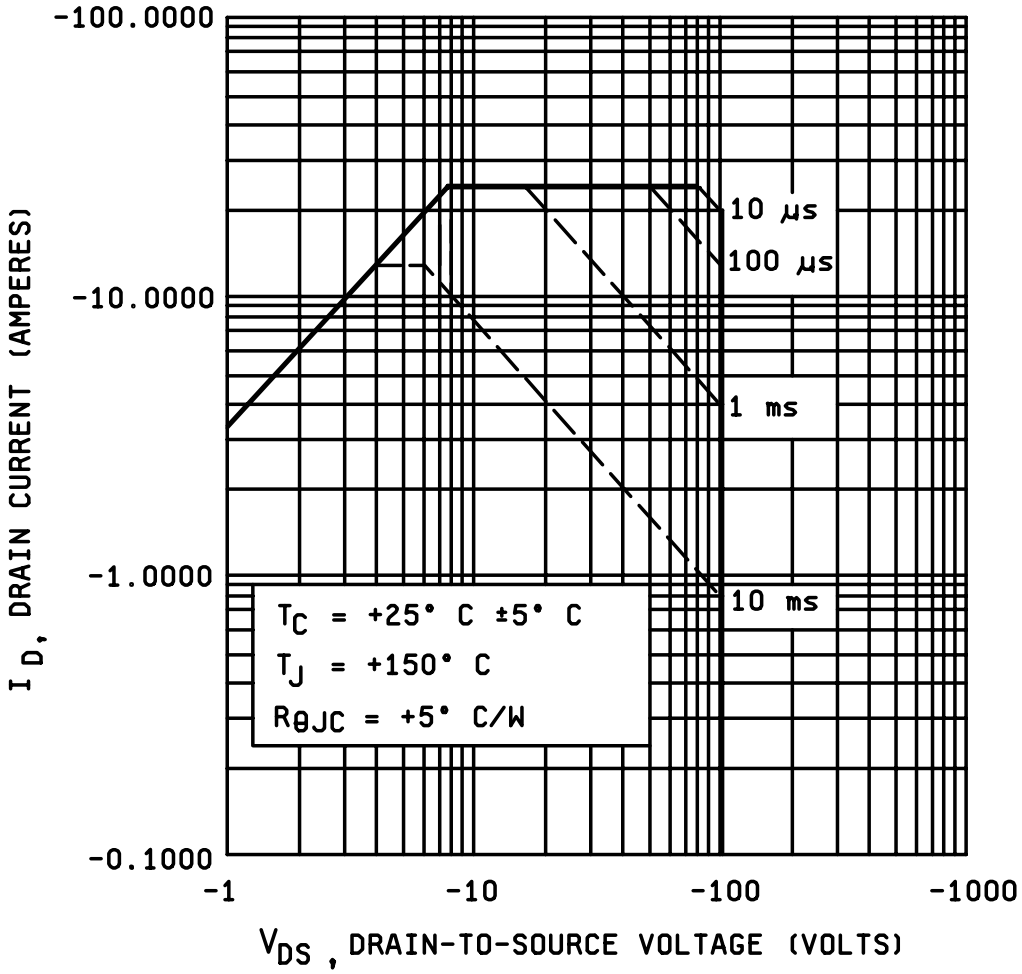
2N6851, 2N6851U

* FIGURE 4. Maximum drain current vs case temperature graphs.



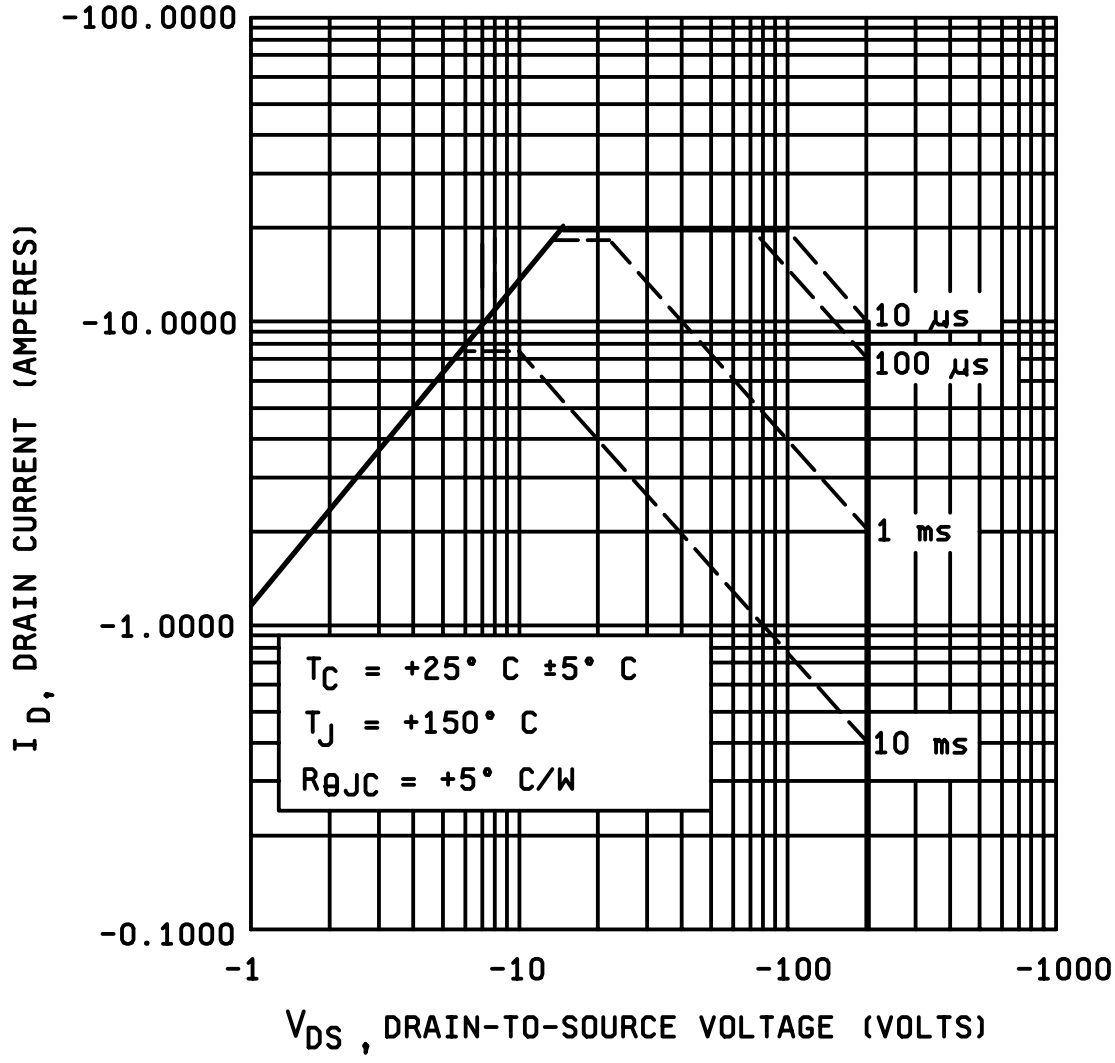
2N6849, 2N6849U, 2N6851, and 2N6851U

FIGURE 5. Normalized transient thermal impedance.



ACTIVE REGION - 2N6849, 2N6849U

FIGURE 6. Maximum safe operating



ACTIVE REGION - 2N6851, 2N6851U

FIGURE 6. Maximum safe operating area - Continued.

5. PACKAGING

* 5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

* 6.1 Intended use. The notes specified in MIL-PRF-19500 are applicable to this specification.

* 6.2 Acquisition requirements. Acquisition documents must specify the following:

a. Title, number, and date of this specification.

b. Issue of DoDISS to be cited in the solicitation and if required, the specific issue of individual documents referenced (see 2.2.1).

c. Packaging requirements (see 5.1).

d. Lead finish (see 3.4.1).

e. Type designation and quality assurance level.

f. For die acquisition, specify the JANHC or JANKC letter version (see figure 3).

* 6.3 Cross-reference and complement list. Parts from this specification may be used to replace the following commercial Part or Identifying Number (PIN's). The term PIN is equivalent to the term part number which was previously used in this specification.

Preferred types	Commercial types (1)
2N6849	IRFF9130, IRFF9131, IRFF9132, IRFF9133
2N6851	IRFF9230, IRFF9231, IRFF9232, IRFF9233
2N6849U	IRFE9130, IRFE9131, IRFE9132, IRFE9133
2N6851U	IRFE9230, IRFE9231, IRFE9232, IRFE9233

(1) Complementary devices can be found on MIL-PRF-19500/557

* 6.4 Suppliers of JANHC and JANKC die. The qualified die suppliers with the applicable letter version (example, JANHCA2N6849) will be identified on the QML.

* 6.5 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Manufacturers' List (QML) whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from Defense Supply Center, Columbus, ATTN: DSCC/VQE, P.O. Box 3990, Columbus, OH 43216-5000.

* 6.6 Changes from previous issue. The margins of this specification are marked with asterisks to indicate where changes from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

Custodians:
Army - CR
Navy - EC
Air Force - 11
NASA - NA
DLA - CC

Review activities:
Army - MI, SM
Navy - AS, MC, TD
Air Force - 19, 70

Preparing activity:
DLA - CC

(Project 5961-2774)

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I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER MIL-PRF-19500/564F	2. DOCUMENT DATE 5 November 2003

3. **DOCUMENT TITLE** SEMICONDUCTOR DEVICE, FIELD EFFECT TRANSISTOR, P-CHANNEL, SILICON TYPES 2N6849, 2N6849U, 2N6851 AND 2N6851U JAN, JANTX, JANTXV, JANS, JANHC, AND JANKC

4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle initial)	b. ORGANIZATION	
c. ADDRESS (Include Zip Code)	d. TELEPHONE (Include Area Code) COMMERCIAL DSN FAX EMAIL	7. DATE SUBMITTED

8. PREPARING ACTIVITY

a. Point of Contact Alan Barone	b. TELEPHONE Commercial 614-692-0510	DSN 850-0510	FAX 614-692-6939	EMAIL alan.barone@.dla.mil
c. ADDRESS Defense Supply Center Columbus ATTN: DSCC-VAC P.O. Box 3990 Columbus, OH 43216-5000	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Standardization Program Office (DLSC-LM) 8725 John J. Kingman, Suite 2533 Fort Belvoir, VA 22060-6221 Telephone (703) 767-6888 DSN 427-6888			